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NOTES FOR STUDENTS.

IN A SOMEWHAT extended paper on geotropism⁵ Dr. F. Noll controverts with much vigor Czapek's theory of geotropism, as expounded recently.⁶ Czapek holds that since gravity and centrifugal force act alike upon plants this can only be because both impart mass acceleration, and this can manifest itself only in pressure of tissue elements or even layers of tissue upon one another. Thus there will be minute differences of radial pressure on different sides of the cortex which must be perceived and responded to by the growing cells. Orthotropic organs seek to equalize such pressures on the flanks; plagiotropic organs (dorsiventral or radial) seek to realize a certain difference of pressure to which they are attuned. To support this view he appeals to the elimination of geotropic effects by the clinostat under proper conditions, and to the behavior of dorsiventral organs both flat and rolled or folded. To this theory Noll strenuously objects. He concludes that the clinostat does not eliminate geotropic stimulation, but only converts the one-sided stimulus of gravity into an all-sided intermittent one. In radial organs rotation prevents curvature, but not in dorsiventral organs, which, even on the clinostat, show geotropic (pseudo-epinastic) curvatures.

Experiments on various organs, ingeniously subjected to artificial radial pressure equal to that of gravity, resulted negatively. Furthermore the behavior of twiners is cited to show that gravity acting tangentially produces acceleration of growth as well as when acting radially. Turning to dorsiventral organs, Noll urges that mere rolling or folding does not suffice to produce orthotropism, but that this is a true geotropic response. He cites physiologically dorsiventral but anatomically radial organs, such as the peduncles of *Tropæolum*, *Linaria*, etc., which with age reverse their anatomical structure, to show that the coarser cell structure has nothing to do with geotropic sensitiveness.

A few years ago Czapek discovered that geotropically stimulated roots treated with reducing reagents react differently from unstimulated ones.⁷ In his later paper (*l.c.*) he declares that this "makes objectively visible the process of perception." To this Noll objects as going too far; the chemical phenomena are rather secondary and are not closely connected with the perception of the stimulus.

At the close of his paper Noll suggests a possible structure for the receptive apparatus, which must be located in the ectoplasm in order to have the necessary fixed orientation. The plasma has a tendency to form globular centrosphere-like bodies and the receptive apparatus may well be analogous

⁵ NOLL, F.: Ueber Geotropismus. *Jahrb. f. wiss. Bot.* 34:457-506. 1900.

⁶ CZAPEK, FRIEDRICH: Weitere Beiträge zur Kenntniss der geotropischen Reizbewegungen. *Jahrb. f. wiss. Bot.* 32:175-308. 1898.

⁷ Berichte d. deutsch. bot. Gesells. 15:516. 1897.

to the otocyst of some lower animals, and have the form of a centrosphere containing a centrosome of different specific gravity from the liquid in which it lies, the wall being locally sensitive to the pressure of the centrosome and functionally connected with the release of action in the growing zone. Such an organ need not be of visible size, and it is unlikely that it is the already known centrosphere connected with cell division.—C. R. B.

ITEMS OF TAXONOMIC interest are as follows: C. L. SHEAR (Bulletin 23, Division of Agrostology, Dept. of Agric.) has published a revision of the N. Am. species of *Bromus* occurring north of Mexico, recognizing 36 species and 28 varieties, 45 of which are native and 19 introduced, and describing 15 new varieties, 3 new species, and a new subgenus (*Neobromus*).—R. E. SCHUH (Rhodora 2:111–112. *pl.* 18. 1900) has described a new genus of brown algæ, calling it *Rhadinocladia*.—T. F. ALLEN (Bull. Torr. Bot. Club 27:299–304. *pls.* 10–15. 1900) has described three new charas from California.—L. F. HENDERSON (*ibid.* 342–359) has described 26 new plants from Idaho and other northwestern localities.—R. CHODAT (Mém. de l'Herb. Boiss. 17:10. 1900) has described three new genera of Protococcoideæ from the plankton flora of the ponds of Denmark, naming them *Lemmermannia*, *Hofmania*, and *Catena*.—F. STEPHANI (*ibid.* 16:1–46. 1900), in continuing his *Species Hepaticarum*, presents *Calycularia* (6 spp.), *Makinoa* (1 sp.), *Cavicularia* (1 sp.), *Blasia* (1 sp.), *Pellia* (3 spp.), *Androcryphia* (1 sp.), *Petalophyllum* (2 spp.), *Treubia* (2 spp.), *Fossombronia* (40 spp.), *Haplomitrium* (1 sp.), and *Calobryum* (3 spp.).—W. N. SUKSDORF (Deutsch. bot. Monats. 18:86–88. 1900), in continuing the publication of Washington plants, describes new species or varieties in the following genera: *Ribes*, *Epilobium*, *Boisduvalia*, *Godetia*.—JAMES BRITTEN and E. G. BAKER (Jour. Bot. 38:241–246. *pl.* 411. 1900) have published some notes on *Eryngium*, with special reference to certain obscure North American species.—J. W. CONGDON (Erythea 7:183–189. 1900) has published a fascicle of new species from Mariposa co., Cal., representing the genera *Sidalcea*, *Ribes*, *Epilobium*, *Echinocystis*, *Selinum*, *Erigeron*, *Wyethia*, *Cnicus*, *Gilia*, *Collinsia*, *Mimulus*, *Castilleja*, and *Orthocarpus*.—A. ENGLER (Bot. Jahrb. 28:291–384. 1900), in continuing his *Beiträge zur Flora von Afrika*, presents the following contributions: M. GÜRKE on Verbenaceæ (II), Boraginaceæ (I), and Labiatae (V); P. HENNINGS on the fungi of eastern Africa; K. SCHUMANN on a new family of Malvales, which he calls *Triplochitonaceæ*, the single genus being *Triplochiton*; A. ENGLER and numerous collaborators on a collection from the lake Nyassa region, abounding in new species.—G. HIERONYMUS (*ibid.* 29:1–35. 1900) has published an account of the Compositae of Ecuador, 270 species being enumerated, many of which are new.—TH. LOESENER (*ibid.* 86–106) has published a second paper on the flora of Central America.—KARL REICHE (*ibid.* 107–119) has published a revision of the South American

family Calyceraceæ.—P. GRAEBNER (*ibid.* 120) has published a revision of *Linnaea*, including *Abelia* under it as a subgenus, the genus thus containing 26 species, 12 of which are new.—The most recent "Contribution from the Gray Herbarium" is by M. L. FERNALD (*Proc. Am. Acad.* 35: 489–573. June 1900). It contains a synopsis of the Mexican and Central American species of the great genus *Salvia*, 209 species being recognized, 57 of which are new; a much needed revision of the Mexican and Central American species of *Solanum* § *Tovaria*, 10 species being presented, four of them new; and some undescribed Mexican seed-plants, 31 in number, chiefly Labiatae and Solanaceæ.—J. M. C.

A NEW THEORY of myrmecophily is proposed by Buscalioni and Huber.⁸ Writing from Pará, Brazil, last September, they say that Schimper's attractive theory, that the symbiosis exists on account of the plant's need of protection against leaf cutting ants, not only fails to account for the facts, but is directly contrary to many. They find myrmecophilous plants restricted to regions subject to present or recent inundation, which points to a connection between this condition and the development of myrmecophily. This connection appears simple: when the low regions were overflowed the ants were compelled to take refuge on the trees and shrubs, and naturally sought out the hollow parts in which to stow away their larvae. The fodder provided for the police-like guests is probably to be ascribed to the direct influence of the ants themselves or of the Aphides or Coccidæ which seek it. As the regions remoter from the streams became less subject to overflow the ants may have retained their dwellings, although the need had passed, while the protection to the plants may have given the latter an advantage over competitors.

The authors state certain consequences of their theory, which so far have proved true:

- 1) If a plant genus consisting of some ant-free and some myrmecophilous species has different species in the upland and in the inundated land, as a rule the upland forms will be free of ants, and only those in the inundated region will be myrmecophilous.

- 2) Those myrmecophilous species which occur on dry land may be derived either from those which occur in inundated localities or they are found in localities which were periodically overflowed in earlier times.

- 3) The myrmecophilous plants of deeply inundated regions are mainly trees; those in regions of shallow overflow are shrubs.

The authors promise the publication shortly of thorough investigations on the biology and anatomy of the ant plants.—C. R. B.

IN HIS RESEARCH on rheotropism of roots Juel used a neat device for obtaining a current of water of uniform rate to impinge upon roots under

⁸ Beihefte zum Bot. Centralbl. 9: 85–88. 1900.

experiment.⁹ To a central disk on the end of a vertical rod are attached six radiating arms of strong brass wire, on which are slipped cork disks, and to them seedlings are fastened in any desired position. This carrier is supported above a circular dish of water into which the roots depend while it is rotated on a clinostat. To prevent the retardation of the water as much as possible three other glass vessels each about 6^{cm} less in diameter than the next outer one are cemented to it, thus dividing the water chamber into three concentric spaces 3^{cm} wide, in which the rate of movement was practically unaffected by the retarding action of the immersed rootlets.

For rheotropic curvatures roots of *Vicia sativa* (2–3^{cm} long) and maize (3–4^{cm} long) proved best adapted. Currents varying from 0.8^m per second (using a hot air motor) to 0.3^{mm} per second were tried. The lower limit of sensitiveness was not reached even at the lowest speed. Curvatures of 15–35° were obtained in 6 hours and 10–65° in 21 hours with currents of 0.8–0.3^{mm} per sec., all being positive, *i. e.*, against the current. After the rheotropic curvature has become considerable a counter curvature due to geotropism appears in *Vicia sativa*, producing a sigmoid form.

By means of decapitation and covering the root tip with collodion caps, Juel sought to determine the receptive region. He concludes that it is the growing zone. Whether or not the tip was also sensitive he could not ascertain. Juel is not yet able to decide what factor acts as a rheotropic stimulus, and plans to make further researches.—C. R. B.

W. C. WORSDELL¹⁰ has done most excellent service in bringing together the chief views in the vexed discussion concerning the nature of the ovular structures in Coniferae. There is probably no more difficult bit of morphology in connection with seed-plants, and the scattered literature of the subject needed organization and compact presentation. The problematical structures are the so-called seminiferous scale and the sporangial envelope. To homologize these structures throughout Coniferae seems to be a well-nigh hopeless task, and a definite solution still remains to be reached.

Mr. Worsdell traces the history of the discussion from Linnaeus (1737) to Celakovsky (1897), although its real beginning on the basis of modern morphology may be said to date from the announcement of gymnospermy by Robert Brown in 1827. The author's judgment favors the conclusions of Celakovsky, who sees in the seminiferous scale the first two leaves of an axillary bud, being developed directly in a highly modified form as an outgrowth on the bract. Furthermore, each of these two leaves represents an outer integument of the sporangium, all of the Coniferous megasporangia

⁹ JUEL, H. O.: Untersuchungen über den Rheotropismus der Wurzeln. Jahrb. f. wiss. Bot. 34: 507–538. 1900.

¹⁰ The structure of the female "flower" in Coniferae, an historical study. Annals of Botany 14: 39–82. 1900.

having two integuments, the outer being transformed in some cases into the so-called aril. This means that no sporophyll or carpel is present in the group.

This view of the seminiferous scale, which combines the old and separate views that it is an axillary shoot, or a ligular or placental outgrowth, or an outer integument, is certainly ingenious, but has the merit of explaining the well-known varying and transitional abnormalities, the reversed orientation of the bundles, and the diverse structures of such forms as *Abies*, *Cupressus*, *Podocarpus*, *Taxus*, etc.—J. M. C.

A WIDENING KNOWLEDGE of reproduction in the lower forms has shown that the line between sexual and asexual reproduction is not so sharp as was formerly imagined and suggests that even in higher plants where parthenogenesis does not normally occur it might possibly be induced by artificial means. The only clearly proven case of parthenogenesis in spermatophytes is furnished by Juel in his account of *Antennaria alpina*. Shaw's experiments led him to believe that in *Marsilea Drummondii* parthenogenesis may occur under normal conditions.

Shaw's work has been confirmed by A. Nathanson,¹¹ who finds that in *M. Drummondii* about 90 per cent. of the megaspores produce parthenogenetic embryos. *M. vestita* was then tried, but the isolated megaspores under otherwise normal conditions produced no embryos. Numerous attempts to induce parthenogenesis by using chemicals were unsuccessful, but by raising the temperature parthenogenetic embryos were obtained. In a lot of 750 isolated megaspores at the temperature of the room only one embryo was found; but in a lot of 466 spores, at a temperature of 35° C., 34 parthenogenetic embryos developed. These embryos when placed in moist soil continued to develop exactly like embryos resulting from fertilized egg cells.

In *M. macra* 101 isolated megaspores at the temperature of the room failed to produce a single embryo, but out of 67 megaspores, at a temperature of 35° C., eight developed parthenogenetic embryos.

The writer satisfied himself that the embryos were truly parthenogenetic and not merely adventitious.—CHARLES J. CHAMBERLAIN.

IN THE *Jour. Roy. Hort. Soc.* (24) is printed a paper by H. J. Webber on the work of the United States Department of Agriculture on plant hybridization. The work thus far undertaken has been mainly on oranges, grapes, pineapples, apples, pears, wheat, corn, and cotton. The account is one of progress rather than of practical improvement, and the scientific results are apt to be even more important than the horticultural results. The

¹¹ Ueber Parthenogenesis bei *Marsilea* und ihre Abhängigkeit von der Temperatur. Ber. d. deutsch. bot. Gesell. 18: 99-110. 1900.

work of the hybridization of oranges and other citrous fruits was done in connection with Mr. W. T. Swingle. The aim has been to secure a hardy orange, one with the loose skin of the mandarin, various changes in quality, and resistance to diseases. In the experiments upon pineapple hybridization the problems presented are to secure better shipping kinds, those with smooth leaves, those resistant to disease, and those with larger fruits and of better quality. The main purpose in the experiments on cotton hybridization has been to improve the upland cotton of the interior by means of the fine Sea Island cotton that at present is grown in such a limited area. In experiments on corn hybridization very few of the important problems have been taken up as yet. Something has been done in the direction of the development of the better yielding races. It is in connection with these experiments upon corn that Mr. Webber has developed a remarkable series of results indicating the immediate effect of pollen, a phenomenon known as *xenia*.—J. M. C.

A SECOND PAPER has appeared on the fertilization of *Batrachospermum* since my account in 1896. Osterhout¹² agrees with Schmidle that a sperm nucleus passes through the trichogyne into the carpogonium and unites with the female nucleus there, and he figures a stage in the process of fusion. Osterhout also is unable to find a nucleus in the trichogyne. It will be remembered that Schmidle¹³ reported that the sperms contained two nuclei, one of which fertilized the carpogonium and the other remained in the sperm or passed into the trichogyne. Osterhout observed only one nucleus in the sperm. If more than one sperm fuses with the trichogyne, their nuclei may enter that structure, but they finally become disorganized. Nuclei that remain in the sperms also break down.

Osterhout's material was fixed after several methods, but that killed in Flemming's strong solution gave the best results. The microtome sections were treated with Flemming's triple stain or with haematoxylin after the method of Heidenhain. The preparations, to judge from the figures, must be much better than any that have yet been made of this plant.—BRADLEY M. DAVIS.

A. C. SEWARD and MISS J. GOWAN¹⁴ have published an extensive paper on *Ginkgo*. An historical account of the development of knowledge concerning this most interesting plant is followed by a detailed description of its structure, and an account of its fossil allies. The authors approve its separation as a distinct group of gymnosperms, and confirm its cycad

¹² OSTERHOUT: Befruchtung bei *Batrachospermum*. *Flora* 87: 109. 1900.

¹³ SCHMIDLE: Einiger über die Befruchtung, Keimung, und Haarinserction von *Batrachospermum*. *Bot. Zeit.* 57: 125. 1899.

¹⁴ The maidenhair tree (*Ginkgo biloba* L.). *Annals of Botany* 14: 109-154. *pls.* 8-10. 1900.

affinities. Its very ancient character is pointed out, the type possibly merging with the Cordaitales in the Palæozoic. During the Mesozoic and Tertiary Ginkgo and its allied forms had a remarkable geographical range, representatives having been discovered in almost all parts of the world.

It is of interest to note that the usual statement that Ginkgo does not occur in the wild state is contradicted, several fine specimens having been found by Mrs. Bishop (Miss Bird) "in the magnificent forests which surround the sources of the Gold river and the smaller Min in western China."—J. M. C.

THE ANATOMY of galls has been recently investigated by Küster.^{15a} The paper treats also of the development and morphology of these peculiar structures. Great attention is paid to galls produced by insects, but those which are due to myxomycetes, fungi, algæ, or worms are considered incidentally.

The principal results are the following: the simplest structure is found where the growth of the infected part is superficial, but widespread histological changes occur when there is growth in thickness. Galls which arise through the enlargement of cells already present are very primitive in their anatomical structure.

The epidermis withstands for the longest time the influence of the irritation, the mesophyll, cortex, and pith being more easily affected. The upper side of the leaf seems less liable to change than the lower. The most important change in the epidermis is the formation of hairs. Stomata often remain permanently open, and in some cases genuine lenticels are formed underneath them.

Assimilative tissue is scanty, but mechanical tissue is usually formed when there is any growth in thickness. The vascular system is feebly developed. The larva-chambers are surrounded by mechanical tissue and in shape repeat the form of the galls. In general, the cells of galls have the same form and arrangement as in normal tissues, but forms of cells and tissues appear in the galls which are not found in normal parts of the same plant, though found in nearly related plants. However, many galls show cell and tissue forms which are not to be found in related plants.

Experimental plant physiology has not yet succeeded in producing new organs or new cell formations. Galls furnish the only evidence that a plant through artificial external influences can produce new tissue forms or cell forms.—CHAS. J. CHAMBERLAIN.

DR. R. H. TRUE, continuing his studies upon the toxicity of acids and salts, finds^{15b} that, given the degree of ionization of an acid and its sodium

^{15a} KÜSTER, ERNST: Beiträge zur Kenntniss der Gallen-anatomie. Flora 87: 117-193. 1900.

^{15b} TRUE, R. H.: The toxic action of a series of acids and of their sodium salts on *Lupinus albus*. Am. Jour. Sci. IV. 9: 183-192. 1900.

salt, the toxic action may be analyzed into the effect of the H ions, the anions, and the undissociated molecules if any. The latter play a particularly important part, especially in the fatty and aromatic series of acids. In general the H ions of inorganic acids are powerfully toxic; the anions of organic acids are slightly toxic, often negligibly so as compared with the H ions; and carboxyl H is many times more toxic than hydroxyl H.—C. R. B.

MR. F. H. KNOWLTON has brought together our knowledge of the fossil plants associated with the lavas of the Cascade range, and has published the result in the Twentieth Annual Report (Part III) of the United States Geological Survey, in connection with an account of the Bohemia mining region of western Oregon. The species number about thirty, including but three ferns and three gymnosperms, and are said to point unmistakably to the Miocene age of the beds.—J. M. C.

PROFESSOR W. A. KELLERMAN, of Ohio State University, and his wife have published an account of the non-indigenous flora of Ohio (University Bulletin, Botanical Series no. 4). In a state known to contain 2025 seed-plants, it seems that 430 of them are not indigenous. These introduced forms are from the following sources: 326 from Europe, 30 from Asia, 2 from Africa, 46 from South and West United States, 21 from Tropical or South America.

PROFESSOR K. MIYAKE, of the imperial University, Tokyo, finds that starch is present in the leaves of evergreens in winter, and that it is due to feeble photosynthesis occurring during that season. The mean temperatures of various days when this process was determined varied from $0.7-7^{\circ}$ C. (mostly less than 3°)¹⁶.—C. R. B.

DR. G. N. BEST has revised the North American species of *Pseudoleskea*.¹⁷ He recognizes seven species, with four varieties, of which three are new. One species, *P. falcicuspis* Kindb., is excluded; and one, *P. atricha* Kindb., is doubtful.—C. R. B.

¹⁶ Bot. Mag., Tokyo, 14: 44. 1900.

¹⁷ Bull. Torr. Bot. Club 27: 221-236. pl. 6, 7. 1900.